PATENT COOPERATION TREATY

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From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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DK-1264 Copenhagen K
DANEMARK

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	26.04.2006

Applicant's or agent's file reference	IMPORTANT NOTIFICATION
P928PC00	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/DK2005/000230	05.04.2005	05.04.2004

Applicant
WEIBEL SCIENTIFIC A/S ET AL.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary report on patentability and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:	Authorized Officer
European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Corapci, M Tel. +31 70 340-2738

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Form PCT/IPEA/416
P928PC00		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/DK2005/000230	05.04.2005	05.04.2004

International Patent Classification (IPC) or national classification and IPC

INV. G01S13/58 G01S7/35

Applicant

WEIBEL SCIENTIFIC A/S ET AL.

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 8 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 11 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in celectronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☒ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
06.02.2006	26.04.2006
Name and mailing address of the international preliminary examining authority:	Authorized officer
European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Roost, J Telephone No. +31 70 340-4423

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages	
1-40	as originally filed
Claims, Numbers	
1-36	received on 08.02.2006 with letter of 08.02.2006
Drawings, Sheets	
1/11-11/11	as originally filed

   ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-36
	No:	Claims	
Inventive step (IS)	Yes:	Claims	6,8-10,13-23,25,26,28-36
	No:	Claims	1-5,7,11,12,24,27
Industrial applicability (IA)	Yes:	Claims	1-36
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item VIII

Certain observations on the international application

1 The application does not meet the requirements of Article 6 PCT, because claims 1, 9, 13 and 22 are not clear.

1.1 Although claims 1, 9, 13 and 22 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

1.2 In particular, **independent claims 13 and 22** appear to contain **all** the features of independent claim 1, and as such could easily have been formulated as being dependent on claim 1.

1.3 It is clear from the description on page 4, line 29 - page 5, line 12, that the following feature is essential to the definition of the invention:

> at least two receivers are arranged along a first receiver direction and at least two receivers are arranged along a second receiver direction, said first receiver direction being different to the second receiver direction.

Since **independent claim 9** does not contain this feature it does not meet the requirement following from Article 6 PCT taken in combination with Rule 6.3(b) PCT that any independent claim must contain all the technical features essential to the definition of the invention.

It is furthermore noted that claim 9, when including this feature, could easily have been formulated as being dependent on claim 1.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

2 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1-5, 7, 11, 12, 24, 27 does not involve an inventive step in the sense of Article 33(3) PCT.

2.1 Independent claim 1

Document D1, which is considered to represent the most relevant state of the art to the subject matter of claim 1, discloses (see D1: the whole document):

A radar system for detection of one or more objects, said system comprising:
a radar wave transmitter for simultaneously transmitting a CW radar signal and a FM-CW radar signal,
a first radar wave receiver for receiving CW and FM-CW radar signals reflected from one or more objects present in a detection range of the radar system,
a first CW mixer for mixing CW transmission signals and reflected CW signals received by the first receiver to produce one or more first CW beat signals, each first CW beat signal relating to the velocity of an object, and
a first FM-CW mixer for mixing FM-CW transmission signals and reflected FM-CW signals received by the first receiver to produce one or more first FM-CW beat signals, each first FM-CW beat signal relating to the distance to and the velocity of an object.

The subject-matter of independent claim 1 differs from the disclosure of D1 in that:

second and third radar wave receivers with corresponding second and third CW mixers and FM/CW mixers are present, and
at least two receivers are arranged along a first receiver direction and at least two receivers are arranged along a second, different receiver direction

The problem to be solved by the present invention may therefore be regarded as determining target angle in two directions

The solution proposed in claim 1 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons.

Document D4 discloses a CW radar system with three receivers arranged in two directions, to determine, from phase differences between the identical receiver

channels, target angle in two directions.
It would be obvious to the person skilled in the art, namely when the same result is to be achieved, to apply these features with corresponding effect to a radar system according to document D1. It would in that case also be obvious to implement the receiver channel layout of D1 to all the channels, thereby arriving at the radar system according to claim 1.

2.2 Dependent claims
Dependent claims 2-5, 7, 11, 12, 24, 27 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, the reasons being as follows:
w.r.t. claims 2-5, 7, 11, 12:
D4 also discloses determining target angle in two substantially perpendicular directions from phase differences between Fourier transformed outputs of the different receiver channels
w.r.t. claim 24:
D1 discloses the use of a "sawtooth" FM-CW signal, i.e. containing a frequency ramp
w.r.t. claim 27:
both D1 and D4 disclose the object velocity being determined on at least part of the produced CW beat signals

3 Independent claims 9, 13, 22

3.1 Furthermore, the above-mentioned (see **Re Item VIII**) lack of clarity notwithstanding, the subject-matter of independent claims 9, 13 and 22 includes all the features of independent claim 1, and in addition the following:
claim 9:

for each CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said CW mixer, and the radar system further comprises means for summing the Fourier transformed outputs corresponding to each of said CW mixer and for determining a number of CW peak frequencies from the summed Fourier transformed CW signals, and/or wherein
for each FM-CW mixer there is corresponding transforming means for taking the

Fourier transform of the beat signal(s) from said FM-CW mixer, and the radar system further comprises means for summing the Fourier transformed outputs corresponding ta each cf said FM-CW mixer and for determining a number of FM-CW peak frequencies from the summed Fourier transformed FM-CW signals.

claim 13:

for each CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said CW mixer, and
for each FM-CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said FM-CW mixer, and wherein said radar system further comprising phase detecting means for detecting phase differences between corresponding reflected CW or FM-CW radar signals, wherein
the phase detecting means are adapted to determine a first phase difference between corresponding reflected CW or FM-CW radar signals received by said at least two radar wave receivers arranged along the first receiver direction, said first phase difference relating to a first object angular direction, and
the phase detecting means are adapted to determine a second phase difference between corresponding reflected CW or FM-CW radar signals received by said at least two radar wave receivers arranged along the second receiver direction, said second phase difference relating to a second object angular direction,
said radar system further comprising means for establishing and maintaining one or more CW track records corresponding to one or more objects, each track record comprising a number of detected CW peak frequencies as a function of time and further holding information of first and second angular directions as a function of time determined from measurements of corresponding first and second phase differences, and/or
said radar system further comprising means for establishing and maintaining one or more FM-CW track records corresponding to one or more objects, each track record comprising a number of detected FM-CW peak frequencies as a function of time and further holding information of first and second angular directions as a function of time determined from measurements of

corresponding first and second phase differences.

claim 22:

a fourth radar wave receiver with corresponding CW and FM-CW mixers
the first and second receivers are arranged horizontally besides each other, the third and fourth receivers are arranged horizontally besides each other, with the third and fourth receivers being arranged vertically below the first and second receivers, respectively, and wherein
for each CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said CW mixer, and
for each FM-CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said FM-CW mixer,
said radar system further comprising phase detecting means for detecting phase differences between corresponding reflected CW or FM-CW radar signals,
wherein the phase detecting means are adapted to determine an azimuth phase difference between the sum of the two Fourier transformed outputs corresponding to the first and third receivers and the sum of the two Fourier transformed outputs corresponding to the second and fourth receivers, and/or
wherein the phase detecting means are adapted to determine an elevation phase difference between the sum of the two Fourier transformed outputs corresponding to the first and second receivers and the sum of the two Fourier transformed outputs corresponding to the third and fourth receivers.

As these three independent claims have features that go beyond those of document D1, which is considered to represent the most relevant state of the art, and also beyond the combination of D1 and D4 or any of the other disclosed prior art documents, the subject-matter of these claims is therefore new (Article 33(2) PCT) and is also considered as involving an inventive step (Article 33(3) PCT).

3.2 Claims 10, 14-21, 23, 25, 26, 28-36 are dependent on claims 9, 13 or 22 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

CLAIMS as amended on 6 February 2006

(78)

1. A radar system for detection of one or more objects, said system comprising:

a radar wave transmitter for simultaneously transmitting a CW radar signal and a FM-CW radar signal,

first, second and third radar wave receivers for receiving CW and FM-CW radar signals reflected from one or more objects present in a detection range of the radar system,

first, second and third CW mixers for mixing CW transmission signals and reflected CW signals received by the first, second and third receiver, respectively, to produce one or more corresponding first, second and third CW beat signals, each first, second and third CW beat signal relating to the velocity of an object, and

first, second and third FM-CW mixers for mixing FM-CW transmission signals and reflected FM-CW signals received by the first, second and third receivers, respectively, to produce one or more corresponding first, second and third FM-CW beat signals, each first FM-CW beat signal relating to the distance to and the velocity of an object, wherein

at least two receivers are arranged along a first receiver direction and at least two receivers are arranged along a second receiver direction, said first receiver direction being different to the second receiver direction.

2. A radar system according to 1, further comprising means for detecting phase differences between corresponding reflected CW or FM-CW radar signals received by at least two different radar wave receivers.

3. A radar system according to claim 2, wherein the phase detecting means are adapted to determine a first phase difference between corresponding reflected CW or FM-CW radar signals received by said at least two radar wave receivers arranged along the first receiver direction, and to determine a second phase difference between corresponding reflected CW or FM-CW radar signals received by said at least

two radar wave receivers arranged along the second receiver direction, said first phase difference relating to a first object angular direction, and said second phase difference relating to a second object angular direction.

4. A radar system according to claim 3, wherein the phase detecting means are adapted to determine the first phase difference from at least two Fourier transformed outputs representing CW or FM-CW signals corresponding to the at least two receivers arranged along the first receiver direction, and to determine the second phase difference from at least two Fourier transformed outputs representing CW or FM-CW signals corresponding to the at least two receivers arranged along the second receiver direction.

5. A radar system according to any one of the claims 1-4, wherein for each CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said CW mixer.

6. A radar system according to claim 5, further comprising means for summing the Fourier transformed outputs corresponding to each of said CW mixer and for determining a number of CW peak frequencies from the summed Fourier transformed CW signals.

7. A radar system according to any one of the claims 1-5, wherein for each FM-CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said FM-CW mixer.

8. A system according to claim 7, further comprising means for summing the Fourier transformed outputs corresponding to each of said FM-CW mixer and for determining a number of FM-CW peak frequencies from the summed Fourier transformed FM-CW signals.

9. A radar system for detection of one or more objects, said system comprising:

a radar wave transmitter for simultaneously transmitting a CW radar signal and a FM-CW radar signal,

first, second and third radar wave receivers for receiving CW and FM-CW radar signals reflected from one or more objects present in a detection range of the radar system,

first, second and third CW mixers for mixing CW transmission signals and reflected CW signals received by the first, second and third receiver, respectively, to produce one or more corresponding first, second and third CW beat signals, each first, second and third CW beat signal relating to the velocity of an object, and

first, second and third FM-CW mixers for mixing FM-CW transmission signals and reflected FM-CW signals received by the first, second and third receivers, respectively, to produce one or more corresponding first, second and third FM-CW beat signals, each first FM-CW beat signal relating to the distance to and the velocity of an object, wherein

for each CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said CW mixer, and the radar system further comprises means for summing the Fourier transformed outputs corresponding to each of said CW mixer and for determining a number of CW peak frequencies from the summed Fourier transformed CW signals, and/or wherein

for each FM-CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said FM-CW mixer, and the radar system further comprises means for summing the Fourier transformed outputs corresponding to each of said FM-CW mixer and for determining a number of FM-CW peak frequencies from the summed Fourier transformed FM-CW signals.

10. A radar system according to any one of the claims 1-9, further comprising:

a fourth radar wave receiver for receiving reflected CW and FM-CW or MF radar signals,

a fourth CW mixer for mixing CW transmission signals and reflected CW signals received by the fourth receiver to produce one or more fourth CW beat signals, each fourth CW beat signal relating to the velocity of an object, and

a fourth FM-CW mixer for mixing FM-CW transmission signals and reflected FM-CW signals received by the fourth receiver to produce one or more fourth FM-

CW beat signals, each fourth FM-CW beat signal relating to the distance to and the velocity of an object, wherein

for the fourth CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said fourth CW mixer, and for the fourth FM-CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said fourth FM-CW mixer,

said radar system further comprising means for summing the Fourier transformed outputs corresponding to the fourth CW mixer and for determining a number of CW peak frequencies from these summed Fourier transformed CW signals, and means for summing the Fourier transformed outputs corresponding to the fourth FM-CW mixer and for determining a number of FM-CW peak frequencies from these summed Fourier transformed FM-CW signals.

11. A radar system according to any one of the claims 1-10, wherein at least two receivers are arranged along a first receiver direction and at least two receivers are arranged along a second receiver direction, said first receiver direction being different to the second receiver direction.

12. A radar system according to claim 1 or 11, wherein the first and second receiver directions are substantially perpendicular to each other.

13. A radar system for detection of one or more objects, said system comprising:

a radar wave transmitter for simultaneously transmitting a CW radar signal and a FM-CW radar signal,

first, second and third radar wave receivers for receiving CW and FM-CW radar signals reflected from one or more objects present in a detection range of the radar system,

first, second and third CW mixers for mixing CW transmission signals and reflected CW signals received by the first, second and third receiver, respectively, to produce one or more corresponding first, second and third CW beat signals, each first, second and third CW beat signal relating to the velocity of an object, and

first, second and third FM-CW mixers for mixing FM-CW transmission signals and reflected FM-CW signals received by the first, second and third receivers, respectively, to produce one or more corresponding first, second and third FM-CW

beat signals, each first FM-CW beat signal relating to the distance to and the velocity of an object, wherein

for each CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said CW mixer, and for each FM-CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said FM-CW mixer, and

wherein at least two receivers are arranged along a first receiver direction and at least two receivers are arranged along a second receiver direction, said first receiver direction being different to the second receiver direction,

said radar system further comprising phase detecting means for detecting phase differences between corresponding reflected CW or FM-CW radar signals, wherein

the phase detecting means are adapted to determine a first phase difference between corresponding reflected CW or FM-CW radar signals received by said at least two radar wave receivers arranged along the first receiver direction, said first phase difference relating to a first object angular direction, and

the phase detecting means are adapted to determine a second phase difference between corresponding reflected CW or FM-CW radar signals received by said at least two radar wave receivers arranged along the second receiver direction, said second phase difference relating to a second object angular direction,

said radar system further comprising means for establishing and maintaining one or more CW track records corresponding to one or more objects, each track record comprising a number of detected CW peak frequencies as a function of time and further holding information of first and second angular directions as a function of time determined from measurements of corresponding first and second phase differences, and/or

said radar system further comprising means for establishing and maintaining one or more FM-CW track records corresponding to one or more objects, each track record comprising a number of detected FM-CW peak frequencies as a function of time and further holding information of first and second angular directions as a function of time determined from measurements of corresponding first and second phase differences.

14. A radar system according to claim 13, further comprising:

a fourth radar wave receiver for receiving reflected CW and FM-CW or MF radar signals,

a fourth CW mixer for mixing CW transmission signals and reflected CW signals received by the fourth receiver to produce one or more fourth CW beat signals, each fourth CW beat signal relating to the velocity of an object, and

a fourth FM-CW mixer for mixing FM-CW transmission signals and reflected FM-CW signals received by the fourth receiver to produce one or more fourth FM-CW beat signals, each fourth FM-CW beat signal relating to the distance to and the velocity of an object, wherein

for the fourth CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said fourth CW mixer, and for the fourth FM-CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said fourth FM-CW mixer.

15. A radar system according to claim 13 or 14, further comprising means for summing the Fourier transformed outputs corresponding to each of said CW mixer and for determining a number of CW peak frequencies from the summed Fourier transformed CW signals.

16. A radar system according to any one of the claims 13-15, further comprising means for summing the Fourier transformed outputs corresponding to each of said FM-CW mixer and for determining a number of FM-CW peak frequencies from the summed Fourier transformed FM-CW signals.

17. A radar system according to any one of the claims 13-16, wherein the phase detecting means are adapted to determine the first phase difference from at least two Fourier transformed outputs representing CW or FM-CW signals corresponding to the at least two receivers arranged along the first receiver direction, and wherein the phase detecting means are adapted to determine the second phase difference from at least two Fourier transformed outputs representing CW or FM-CW signals corresponding to the at least two receivers arranged along the second receiver direction.

18. A radar system according to any one of the claims 13-17, wherein the first and second receiver directions are substantially perpendicular to each other.

19. A radar system according to any one of the claims 13-18, wherein at least two receivers are arranged horizontally besides each other, whereby a detected time or phase difference between corresponding radar signals received by the two horizontally arranged receivers relates to an azimuth phase difference.

20. A radar system according to any one of the claims 13-19, wherein at least two receivers are arranged vertically above each other, whereby a detected time or phase difference between corresponding radar signals received by the two vertically arranged receivers relates to an elevation phase difference.

21. A radar system according to any one of the claims 13-20, wherein the phase detecting means are adapted to determine first and second phase differences for Fourier transformed outputs corresponding to a selected CW peak frequency, and for Fourier transformed outputs corresponding to a selected FM-CW peak frequency.

22. A radar system for detection of one or more objects, said system comprising:

a radar wave transmitter for simultaneously transmitting a CW radar signal and a FM-CW radar signal,

first, second, third and fourth radar wave receivers for receiving CW and FM-CW radar signals reflected from one or more objects present in a detection range of the radar system,

first, second, third and fourth CW mixers for mixing CW transmission signals and reflected CW signals received by the first, second, third and fourth receivers, respectively, to produce one or more corresponding first, second, third and fourth CW beat signals, each first, second, third and fourth CW beat signal relating to the velocity of an object, and

first, second, third and fourth FM-CW mixers for mixing FM-CW transmission signals and reflected FM-CW signals received by the first, second, third and fourth receivers, respectively, to produce one or more corresponding first, second, third and fourth FM-CW beat signals, each first FM-CW beat signal relating to the distance to and the velocity of an object, wherein

the first and second receivers are arranged horizontally besides each other, the third and fourth receivers are arranged horizontally besides each other, with the

third and fourth receivers being arranged vertically below the first and second receivers, respectively, and wherein

for each CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said CW mixer, and

for each FM-CW mixer there is corresponding transforming means for taking the Fourier transform of the beat signal(s) from said FM-CW mixer,

said radar system further comprising phase detecting means for detecting phase differences between corresponding reflected CW or FM-CW radar signals,

wherein the phase detecting means are adapted to determine an azimuth phase difference between the sum of the two Fourier transformed outputs corresponding to the first and third receivers and the sum of the two Fourier transformed outputs corresponding to the second and fourth receivers, and/or

wherein the phase detecting means are adapted to determine an elevation phase difference between the sum of the two Fourier transformed outputs corresponding to the first and second receivers and the sum of the two Fourier transformed outputs corresponding to the third and fourth receivers.

23. A radar system according to claim 22, further comprising means for summing the Fourier transformed outputs corresponding to each of said CW mixer and for determining a number of CW peak frequencies from the summed Fourier transformed CW signals, and further comprising means for summing the Fourier transformed outputs corresponding to each of said FM-CW mixer and for determining a number of FM-CW peak frequencies from the summed Fourier transformed FM-CW signals.

24. A radar system according to any one of the claims 1-23, wherein the radar wave transmitter is adapted for simultaneously transmitting a CW radar signal and a FM-CW radar signal, wherein the FM-CW radar signal is a ramp modulated signal.

25. A radar system according to claim 24, wherein the ramp modulated signal has an up-ramp waveform with an increase in frequency during the up-ramp period or a down-ramp waveform with a decrease in frequency during the down ramp period.

26. A radar system according to any one of the claims 1-23, wherein

the radar wave transmitter is adapted for simultaneously transmitting a CW radar signal and a FM-CW radar signal, wherein the FM-CW radar signal has a triangular shaped waveform with up-ramp periods having an increase in frequency and down-ramp periods having a decrease in frequency.

27. A radar system according to any one of the claims 1-26, further comprising means for determining an object velocity or an relative object velocity of one or more objects based on at least part of the produced CW beat signals.

28. A radar system according to any one of the claims 6-27, further comprising means for determining a CW object velocity based on a selected CW peak frequency, said CW object velocity corresponding to the velocity or the relative velocity of an object providing a Doppler frequency corresponding to the selected CW peak frequency.

29. A radar system according to any one of the claims 8-28, wherein the radar wave transmitter is adapted for transmitting a FM-CW radar signal having a triangular waveform with the frequency being increased at a given first rate and decreased at said first rate, and wherein the radar system comprises:

means for selecting from the determined FM-CW peak frequencies a pair of FM-CW peak frequencies corresponding to consecutive up- and down ramps of the transmitted FM-CW signal,

means for determining a FM-CW object velocity based on the selected pair of FM-CW peak frequencies,

means for comparing the determined FM-CW object velocity with one or more determined CW object velocities to thereby obtain a CW peak frequency corresponding to the selected pair of FM-CW peak frequencies, and

means for determining an object distance from the selected pair of FM-CW peak frequencies or from the corresponding CW peak frequency and at least one of the selected pair of FM-CW peak frequencies.

30. A radar system according to any one of the claims 13-21, further comprising means for, based on a selected track record holding CW peak frequency information and information of first and second angular directions as a function of time, predicting for an object corresponding to said selected track record expected CW peak

frequencies and first and second angular information at a required time posterior to the time of the last stored peak frequency information of said selected track record.

31. A radar system according to any one of the claims 13-21, further comprising means for, based on a selected track record holding FM-CW peak frequency information and information of first and second angular directions as a function of time, predicting for an object corresponding to said selected track record expected FM-CW peak frequencies and first and second angular information at a required time posterior to the time of the last stored peak frequency information of said selected track record.

32. A radar system according to any one of the claims 13-21, further comprising means for selecting from the CW track records and the FM-CW track records one or more pairs of CW and FM-CW peak frequencies having corresponding first and second angular directions or corresponding azimuth and elevation angles, and for determining from an obtained pair of CW and FM-CW peak frequencies an object velocity and a corresponding object distance.

33. A radar system according to claim 29 or 32, further comprising means for establishing and maintaining one or more track records holding combined CW and FM-CW peak frequency information as a function of time for one or more objects having a velocity and distance determined from a pair of previously measured CW and/or FM-CW peak frequencies having corresponding velocities.

34. A radar system according to claim 33, further comprising means for, based on a selected track record holding combined CW and FM-CW peak frequency information as a function of time, predicting for an object corresponding to said selected track record expected CW and FM-CW peak frequencies at a required time posterior to the time of the last stored peak frequency information of said selected track record.

35. A radar system according to claim 32, further comprising means for establishing and maintaining one or more track records holding combined CW and FM-CW peak frequency information and information of first and second angular directions as a function of time for one or more objects having a velocity and distance determined

from a pair of previously measured CW and FM-CW peak frequencies having corresponding first and second angular directions.

36. A radar system according to claim 35, further comprising means for, based on a selected track record holding combined CW and FM-CW peak frequency information and information of first and second angular directions as a function of time, predicting for an object corresponding to said selected track record expected CW and FM-CW peak frequencies and information of first and second angular directions at a required time posterior to the time of the last stored peak frequency information of said selected track record.